High-Altitude Meteors and Meteoroid Fragmentation Observed at Jicamarca

J.D. Mathews*, B. Gao, J. Urbina, and F. Galindo
Radar Space Sciences Lab, Pennsylvania State University, University Park, PA 16802, USA

One of the most exciting—but somewhat controversial—recent developments in the meteor physics community has been identification of fragmentation signatures in perhaps the majority of meteoroids observed by many of the High Power Large Aperture (HPLA) radars. The identification of fragmentation has been based detailed radio science interpretation of head- and trail-echo properties. Now we report on observations of high altitude (140 – 180 km) meteors observed at the Jicamarca Radio Observatory (JRO). Though there have been a few reports of high altitude meteors observed both optically and with radar, the community has remained somewhat skeptical with suspicions of sidelobe contamination being perhaps the most common objection. We report results from two sets of April 2010 (and some summer 2012) observations at JRO during which an uncoded 20 μsec pulse was used for meteor observations. This observing mode parallels that used with the Arecibo 46.8 MHz radar that has similar sensitivity to JRO in 1/64-panel interferometry mode thus allowing some direct comparisons. Our findings include meteoroid fragmentation results that are similar to those from the Arecibo VHF radar and lead to the conclusion that fragmentation is not only observed at Jicamarca but that $\mathbf{k}\perp\mathbf{B}$ scattering adds an interesting radio science dimension to the issue. We additionally report on surprisingly common high-altitude meteor events that offer insight into sputtering as a source of the meteor ionization and perhaps indicate the unique importance of the magnetic field geometry in these head-echo observations. In presenting the high-altitude meteor results, we note the careful calibration of the JRO 50 MHz radar we performed in order to exclude sidelobe contamination and other possible error sources. The calibration procedure utilized satellite returns with great success as reported in a separate presentation.